

## CLAIMS

What is claimed is:

1. A method, comprising:

establishing a distribution pattern to distribute multilink frame relay (MFR)

fragments, the distribution pattern including a sequence of link entries

associated with links in a link bundle, wherein each link entry is identified

when the associated link is capable of transmitting a fragment in a fastest

transmit time, wherein the fastest transmit time is determined based on the

link speed of the link and a transmit time for the link to transmit other

fragments previously allocated to that link; and

distributing the fragments according to the distribution pattern from a first link entry

to a last link entry in the distribution pattern, wherein the distribution pattern is

repeated after the last link entry.

2. The method of claim 1, wherein a number of link entries in the distribution

pattern is determined by dividing a total link speed of the link bundle by a minimum

possible link speed supported by a system.

3. The method of claim 1, wherein the fastest transmit time is further determined

based on a fragment size.

1 4. The method of claim 3, wherein when more than one link is capable of  
2 transmitting a fragment in a fastest transmit time, the link entry is identified based  
3 on an associated link having a fastest link speed.

1 5. The method of claim 1, wherein the transmit time for the link to transmit other  
2 fragments previously allocated to that link is accumulative until the last link entry in  
3 the distribution pattern is determined.

1 6. The method of claim 1, wherein distributing the fragments according to the  
2 distribution pattern comprises:

3 selecting a link entry from the distribution pattern in the sequence from the  
4 first link entry to the last link entry;  
5 determining if a link associated with the selected link entry has available  
6 credit;  
7 when the link has available credit, distributing the fragment to the link and  
8 reducing the credit available to that link; and  
9 when the link does not have available credit, selecting a next link entry in  
10 the sequence.

1 7. The method of claim 6, wherein the credit is allocated to each link based on  
2 the link speed and a periodic interval gap.

1 8. The method of claim 6, wherein the distribution pattern is repeated at the first  
2 link entry and before selecting the last link entry, after expiration of a

3 predetermined waiting time period to receive a fragment to be distributed to a link  
4 in the link bundle.

1 9. The method of claim 1, wherein the distribution pattern is implemented as an  
2 array data structure.

1 10. A method, comprising:

2 determining a number of positions in a distribution pattern;

3 identifying a link entry for a first position in the distribution pattern, comprising:

4 selecting a link in the link bundle that is capable of transmitting a

5 first fragment in a fastest time based on the link speed of each link, a total

6 transmit time associated with each link, and a fragment size;

7 placing a link entry associated with the selected link in the first position in the

8 distribution pattern;

9 adding the fastest transmit time to the total transmit time associated with the

10 selected link; and

11 repeating said identifying for a link entry for a next position in the distribution

12 pattern to transmit a next fragment until a link entry is selected for all positions

13 in the distribution pattern.

1 11. The method of claim 10, wherein the number of positions in the distribution

2 pattern is based on a total link speed of links in a link bundle and a minimum

3 possible link speed of a link supported by a system.

1 12. The method of claim 10, wherein when there is more than one link having the  
2 same fastest transmit time, a link associated with a fastest link speed is selected.

1 13. The method of claim 10, further comprising distributing fragments according to  
2 the distribution pattern from the link entry in the first position to a link entry in a last  
3 position in the distribution pattern, wherein the distribution pattern is repeated after  
4 the link entry in the last position.

1 14. The method of claim 13, wherein distributing the fragments according to the  
2 distribution pattern comprises:

3 selecting a link entry from the distribution pattern in a sequence from the  
4 first position to the last position;

5 determining if a link associated with the selected link entry has available  
6 credit;

7 when the link has available credit, distributing a current fragment to the link  
8 and reducing the available credit for that link; and

9 when the link does not have available credit, selecting a next link entry in  
10 the sequence.

1 15. The method of claim 14, wherein the credit is allocated to each link based on  
2 the link speed and a periodic interval gap.

1 16. A computer readable medium having stored thereon sequences of instructions  
2 which are executable by a system, and which, when executed by the system,  
3 cause the system to:

4 establish a distribution pattern to distribute multilink frame relay (MFR)  
5 fragments, the distribution pattern including a sequence of link entries associated  
6 with links in a link bundle, wherein each link entry is placed in the distribution  
7 pattern when the link is capable of transmitting a fragment in a fastest transmit  
8 time, the fastest transmit time determined based on the link speed of the link and a  
9 transmit time for the link to transmit other fragments previously allocated to the  
10 link; and

11 distribute the fragments according to the distribution pattern from a first link  
12 entry to a last link entry in the distribution pattern, wherein the distribution pattern  
13 is repeated after the last link entry.

1 17. The computer readable medium of claim 16, wherein the number of link entries  
2 in the distribution pattern is determined by dividing a total link speed of the link  
3 bundle by a minimum possible link speed supported by a system.

1 18. The computer readable medium of claim 16, wherein the fastest transmit time  
2 is further determined based on a fragment size.

1 19. The computer readable medium of claim 16, wherein when more than one link  
2 is capable of transmitting a fragment in a fastest transmit time, the link entry is  
3 determined based on an associated link having a fastest link speed.

1 20. The computer readable medium of claim 16, wherein the transmit time for the  
2 link to transmit other fragments previously allocated to that link is accumulative  
3 until the last link entry in the distribution pattern is determined.

1 21. The computer readable medium of claim 16, wherein the instructions to  
2 distribute the fragments according to the distribution pattern comprises instructions  
3 to:

4 select a link entry from the distribution pattern in the sequence from the

5 first link entry to the last link entry;

6 determine if a link associated with the selected link entry has available

7 credit;

8 when the link has available credit, distribute the fragment to the link and

9 reduce the credit available to that link; and

10 when the link does not have available credit, select a next link entry in the

11 sequence.

1 22. The computer readable medium of claim 21, wherein the credit is allocated to  
2 each link based on the link speed and the periodic interval gap.

23. The computer readable medium of claim 16, wherein the distribution pattern is repeated at the first link entry and before selecting the last link entry after expiration of a predetermined waiting time period to receive a fragment to be distributed to a link in the link bundle.

24. The computer readable medium of claim 16, wherein the distribution pattern is implemented as an array data structure.

25. A computer readable medium having stored thereon sequences of instructions which are executable by a system, and which, when executed by the system, cause the system to:

determine a number of positions in a distribution pattern;

identify a link entry for a first position in the distribution pattern, comprising

instructions to:

select a link in the link bundle that is capable of transmitting a first fragment

in a fastest time based on the link speed of each link, a total transmit

time associated with each link, and a fragment size;

place a link entry associated with the selected link in the first position in the

distribution pattern; and

add the fastest transmit time to the total transmit time associated with the

selected link; and

repeat said instructions to identify for a link entry for a next position in the

distribution pattern to transmit a next fragment until a link entry is

16        selected for all positions in the distribution pattern.

1    26. The computer readable medium of claim 25, wherein the number of positions  
2    in the distribution pattern is based on a total link speed of links in a link bundle and  
3    a minimum possible link speed supported by a system.

1    27. The computer readable medium of claim 25, wherein when there is more than  
2    one link having the same fastest transmit time, a link associated with a fastest link  
3    speed is selected.

1    28. The computer readable medium of claim 25, further comprising instructions to  
2    distribute fragments according to the distribution pattern from the link entry in the  
3    first position to a link entry in a last position in the distribution pattern, wherein the  
4    distribution pattern is repeated after the link entry in the last position.

1    29. The computer readable medium of claim 28, wherein the instructions to  
2    distribute the fragments according to the distribution pattern comprises instructions  
3    to:

4        select a link entry from the distribution pattern in a sequence from the  
5        first position to the last position;

6        determine if a link associated with the selected link entry has available  
7        credit;

8        when the link has available credit, distribute a current fragment to the link





1 33. The system of claim 31, wherein a number of link entries in the distribution  
2 pattern is determined by dividing a total link speed of the link bundle by a minimum  
3 possible link speed supported by the system.

1 34. The system of claim 31, wherein the fastest transmit time is further determined  
2 based on a fragment size.

1 35. The system of claim 34, wherein when more than one link is capable of  
2 transmitting a current fragment in the fastest transmit time, a link entry associated  
3 with a link having a fastest link speed is placed in the distribution pattern.

36. The system of claim 31, wherein the transmit time for the link to transmit other fragments previously allocated to that link is accumulative until the last link entry in the distribution pattern is determined.

1 37. The system of claim 32, wherein, to distribute the fragments according to the  
2 distribution pattern, the processor is configured to:

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3         select a link entry from the distribution pattern in the sequence from the
4             first link entry to the last link entry;

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5           determine if a link associated with the selected link entry has available  
6           credit;

7      when the link has available credit, distribute the fragment to the link and

8           reduce the credit available to that link; and

9 when the link does not have available credit, select a next link entry in

10 the sequence.

1 38. The system of claim 37, wherein the credit is allocated to each link based on  
2 the link speed and a periodic interval gap.

1 39. The system of claim 31, wherein the distribution pattern is repeated at the first  
2 link entry and before selecting the last link entry after expiration of a  
3 predetermined waiting time period to receive a fragment to be distributed to a link  
4 in the link bundle.

1 40. The system of claim 31, wherein the distribution pattern is implemented as an  
2 array data structure.

1 41. A system, comprising:  
2 means for establishing a distribution pattern to distribute multilink frame relay  
3 (MFR) fragments, the distribution pattern including a sequence of link entries  
4 associated with links in a link bundle; and  
5 means for distributing the fragments according to the distribution pattern from  
6 a first link entry to a last link entry in the distribution pattern, wherein the  
7 distribution pattern is repeated after the last link entry.

1 42. The system of claim 41, wherein the means for distributing the fragments  
2 according to the distribution pattern comprises means for selecting a link entry  
3 from the distribution pattern based on available credit.

1 43. The system of claim 41, wherein the means for distributing the fragments  
2 according to the distribution pattern comprises means detecting expiration of a  
3 predetermined waiting period and means for resetting to the first entry in the  
4 distribution pattern.

1 44. A method, comprising:  
2 establishing a distribution pattern to distribute multilink frame relay (MFR)  
3 fragments, the distribution pattern including a sequence of link entries  
4 associated with links in a link bundle; and  
5 distributing the fragments according to the distribution pattern from a first link entry  
6 to a last link entry in the distribution pattern, wherein the distribution pattern is  
7 repeated after the last link entry.

1 45. The method of claim 44, wherein a number of link entries in the distribution  
2 pattern is determined by dividing a total link speed of the link bundle by a minimum  
3 possible link speed supported by a system.

1 46. The method of claim 44, wherein each link entry in the distribution pattern is  
2 determined based on the associated link being able to transmit a fragment in a  
3 fastest transmit time, the fastest transmit time determined based on the link speed  
4 of the link, a fragment size, and a transmit time for the link to transmit other  
5 fragments previously allocated to that link.

1 47. The method of claim 46, wherein when more than one link is capable of  
2 transmitting a fragment in the fastest transmit time, the link entry is determined  
3 based on an associated link having a fastest link speed.

48. The method of claim 44, wherein the transmit time for the link to transmit other fragments previously allocated to that link is accumulative until the last link entry in the distribution pattern is determined.

1 49. The method of claim 44, wherein the fragments are further distributed based  
2 on available credit.

50. An apparatus, comprising:

- a link bundle including two or more links, the link bundle configured to transmit multilink frame relay (MFR) fragments according to a distribution pattern, wherein the distribution pattern comprises link entries associated with each of the two or more links in the link bundle.

51. The apparatus of claim 50, wherein a number of entries in the distribution pattern is determined by dividing a total speed of the links in the link bundle by a minimum possible link speed supported by a system.

1 52. The apparatus of claim 50, wherein the distribution pattern is repeated after a  
2 last link entry.

1 53. The apparatus of claim 50, wherein each link entry in the distribution pattern is  
2 identified based on a link speed of a link and a transmit time for the link to transmit  
3 other fragments previously allocated to that link.

1 54. An apparatus, comprising:  
2 means for transmitting multilink frame relay (MFR) fragments according to a  
3 distribution pattern, wherein the distribution pattern comprises link entries  
4 associated with links in a link bundle.

1 55. The apparatus of claim 54, further comprising means for determining a  
2 number of entries in the distribution pattern.

1 56. The apparatus of claim 54, further comprising means for identifying each link  
2 entry in the distribution pattern.